CLAIMS

1. A laser source scalable to provide a high power output beam of good beam quality, the laser source comprising:

a solid state laser amplifier providing a high power output beam;

an array of laser fiber amplifiers providing an input beam to the solid state laser;

a phase and polarization sensor, for sensing phase and polarization variations in a cross section of the output beam from the solid state laser; and

means for controlling phase and polarization of elements of the array of laser fiber amplifiers, to achieve phase and polarization control through the cross section of the output beam;

whereby precise phase and polarization control is effected even the output beam is of high power.

2. A laser source as defined in claim 1, wherein the phase and polarization sensor comprises:

means for sampling the output beam throughout its cross section; and

means for comparing the phase and polarization of output beam samples with a reference beam;

and wherein the means for controlling phase and polarization comprises separate phase and polarization control elements for each element of the array of laser fiber amplifiers, and wherein the output beam phase and polarization is conformed to qualities of the reference beam.

3. A laser source as defined in claim 2, wherein the reference beam and multiple inputs to the array of laser fiber amplifiers are all derived from a common master oscillator.

4. A laser source as defined in claim 1, wherein the array of laser fiber amplifiers comprises:

multiple inputs derived from a common master oscillator;

a diode pump source coupled to the laser fiber amplifiers to provide pump power; and

an array of collimating lenses coupled to corresponding fiber outputs and arranged in a closely packed configuration to launch the multiple fiber outputs as an input to the solid state laser.

5. A laser source as defined in claim 4, wherein:

the solid state laser is diode pumped.

6. A laser source as defined in claim 4, wherein:

the solid state laser is selected from the group consisting of a rod laser, a slab laser, a disk laser and a heat capacity laser.

7. A laser source as defined in claim 4, wherein the phase and polarization sensor comprises:

a beam sampler for obtaining a sample of the output beam;

a reference beam source derived from the common master oscillator;

optical means for comparing the sample of the output beam with the reference beam; and

a sensor lens array for spatially sampling the sensed phase and polarization differences across the output beam cross section.

8. A hybrid laser source scalable to high powers, the laser source comprising:

a master oscillator and related amplifier producing a laser seed beam of desired quality and spectral content;

a plurality of fiber laser amplifiers coupled to receive the laser seed beam derived from the master oscillator;

a plurality of diode pump sources coupled to the fiber laser amplifiers to provide amplification;

a collimator lens array coupled to receive output beams from the fiber laser amplifiers and configured in a compact configuration to provide a composite output beam from the fiber laser amplifiers;

a solid state laser positioned to receive the composite output beam from the fiber laser amplifiers, and pumped by diodes to generate an amplified output beam;

a phase and polarization sensor positioned in the solid state laser output beam and configured to produce a plurality of phase and polarization difference signals corresponding spatially to the positions of lenses in the collimator lens array;

a phase and polarization controller, for generating electrical control signals to achieve a desired predistortion of phase and polarization of the optical beams input to the fiber laser amplifiers; and

a plurality of phase and polarization control elements coupled to the fiber laser amplifier inputs to achieve the desired predistortion of phase and polarization.

9. A hybrid laser source as defined in claim 8, wherein the phase and polarization distortion signals applied to the fiber laser amplifier inputs are selected to conform the solid state laser output beam to the phase and polarization qualities of a reference beam derived from the master oscillator.

10. A hybrid laser source as defined in claim 8, wherein the phase and polarization distortion signals applied to the fiber laser amplifier inputs are selected to effect a desired wavefront tilt or other distortion in the solid state laser output beam.

11. A method for generating a laser beam of high power and good beam quality, comprising the steps of:

generating a seed beam of desired beam quality and spectral content;

applying the seed beam to multiple fiber laser amplifiers;

pumping the fiber laser amplifiers to produce an array of amplified output beams from the fiber laser amplifiers;

focusing the output beams from the fiber laser amplifiers into a solid state laser;

pumping the solid state laser to produce a composite output beam;

sampling the composite output beam and sensing phase and polarization differences at a plurality of spatial positions in a cross section of the

composite output beam, the spatial positions corresponding to the positions of the fiber laser amplifiers providing input to the solid state laser;

generating phase and polarization control signals corresponding to the sensed polarization differences; and

predistorting the phase and polarization of the seed beam applied to the inputs of the fiber laser amplifiers, to achieve desired phase and polarization properties in the output beam from the solid state amplifier.

12. A method as defined in claim 11, wherein:

the sensed phase and polarization differences result from a comparison between the phase and polarization of a reference signal and the phase and polarization properties sampled in the cross section of the solid state laser output signal; and

the step of predistorting the phase and polarization has the effect of compensating of phase and polarization distortions arising in the solid state laser.

13. A method as defined in claim 11,wherein:

the step of predistorting the phase and polarization has the effect of achieving a desired change in wavefront tilt or focus of the solid state laser output beam.